

WHAT IS CLAIMED IS:

1. A method for assigning tester interface pins to tester fixture probes
in a constrained pin-to-probe assignment problem describing a printed circuit
board tester environment, said constrained pin-to-probe assignment problem
defined by a set of constraints, said set of constraints including: a set of
nodes each needing at least one resource, a plurality of tester resources
wherein said plurality of resources may comprise a plurality of non-disjoint
groupings of resources wherein each grouping realizes a test, a plurality of
tester interface pins each connectable to one or more of said tester
resources and may be physically grouped into one or more tester modules,
said plurality of tester interface pins comprising a plurality of disjoint pin
groupings wherein each pin grouping comprises a plurality of tester interface
pins that are multiplexed together and that cannot be used simultaneously in
any given test, a plurality of probes each connectable to at least one node
and to only one of said tester interface pins to deliver a single tester
resource to said node during any given test and the same or a different
tester resource for any other given test, and wherein no two nodes can share
a pin, and a plurality of tests which may include a subset of tests where each
test in said subset of tests requires tester resources to be delivered and/or
measured from said tester interface pins from a single given module of said
one or more tester modules, said method comprising:
modeling said constrained pin-to-probe assignment problem as a
Matching Problem that satisfies said set of constraints; and
solving said Matching Problem that satisfies said set of constraints to
generate a solution to said constrained pin-to-probe assignment problem.

2. A method in accordance with claim 1, wherein:
said solution comprises a maximum matching.

3. A method in accordance with claim 1, wherein:
said solving step generates a plurality of solutions, each said solution
having an associated priority.

4. A method in accordance with claim 3, further comprising:
2 selecting a solution from said plurality of solutions, said selected
solution having a corresponding priority that is relatively equal to or higher
4 than each of said respective priorities associated with each other of said
plurality of solutions.

5. A method in accordance with claim 1, wherein:
2 said step for modeling said pin-to-probe assignment problem as a
Matching Problem that satisfies said constraints comprises:
4 for each of said plurality of probes connectable to deliver more than
one tester resource:
6 for each tester resource greater than one:
creating a dummy probe, said dummy probe comprising
8 a virtual probe that operates as a placemaker for said probe;
mapping said tester resource to said dummy probe;
10 unmapping said tester resource from said probe; and
associating said dummy probe with said probe; and
12 wherein said step for solving said Matching Problem that satisfies said
set of constraints comprises:
14 once a solution to said Matching Problem that satisfies said set of
constraints is obtained, reassigning each pin in the solution that has been
16 assigned to a dummy probe to the probe associated with the dummy probe
and removing said dummy probe from said solution.

6. A method in accordance with claim 1, wherein:
2 said step for modeling said pin-to-probe assignment problem as a
Matching Problem that satisfies said constraints comprises:
4 for each test in said subset of tests that requires tester resources to
be delivered and/or measured from said tester interface pins from a single
6 given module of said one or more tester modules:
for each module that provides all tester resources required by
8 said test:
for each said tester resources required by said test:
10 for each probe that handles said resource:

if said probe is unmapped:
12 mapping said resource to said
probe;
14 if said probe is mapped:
creating a dummy probe;
16 mapping said resource to said
dummy probe;
18 associating said dummy probe with
said probe; and
20 mapping said dummy probe to said
tester interface pins in said module that
22 can connect to said resource in said
module; and
24 wherein said step for solving said Matching Problem that satisfies said
set of constraints comprises:
26 once said solution to said constrained pin-to-probe assignment
problem is obtained, for each test in said subset of tests that requires tester
28 resources to be delivered and/or measured from said tester interface pins
from a single given module of said one or more tester modules:
30 selecting one of said modules that provides all tester resources
required by said test in which a pin-to-probe assignment solution is
32 found;
reassigning each pin in said solution that has been assigned to
34 a dummy probe to the probe associated with the dummy probe and
removing said dummy probe from said solution;
36 and for each remaining module that provides all tester resources
required by said test, removing all portions of said solution associated with
38 said test from said remaining module.

7. A method in accordance with claim 6, wherein:
2 said step for selecting one of said modules that provides all tester
resources required by said test in which a pin-to-probe assignment solution
4 is found comprises:

selecting said module in which said pin-to-probe assignment solution
6 for said test is the least- or equally-least cost solution.

8. A method in accordance with claim 1, wherein:

2 for each test:

for each said plurality of disjoint pin groupings wherein each pin
4 grouping comprises a plurality of tester interface pins that are multiplexed
together and that cannot be used simultaneously in any given test:

6 determining whether said solution to said constrained pin-to-probe
assignment problem contains pin-to-probe assignments that include pins
8 from said disjoint pin grouping; and

if said solution to said constrained pin-to-probe assignment problem
10 contains pin-to-probe assignments that do include pins from said disjoint pin
grouping, said step for solving said Matching Problem that satisfies said set
12 of constraints is repeated to generate an alternative solution to said
constrained pin-to-probe assignment problem, if said alternative solution
14 exists.

9. A method in accordance with claim 1, wherein said step for solving
2 said Matching Problem that satisfies said set of constraints to generate a
solution to said constrained pin-to-probe assignment problem comprises:

4 initializing said solution to an empty set and a flow associated with
said solution to zero;

6 searching for a flow-augmenting path that satisfies said set of
constraints;

8 if said flow-augmenting path is found, replacing said matching solution
with the Exclusive-OR function of the matching solution and the flow-
10 augmenting path;

augmenting said flow along said flow-augmenting path; and
12 repeating said searching step through said repeating step until a flow-
augmenting path is not found.

10. A method in accordance with claim 5, wherein:

2 said step for modeling said pin-to-probe assignment problem as a
Matching Problem that satisfies said constraints comprises:

4 for each test in said subset of tests that requires tester resources to
be delivered and/or measured from said tester interface pins from a single
6 given module of said one or more tester modules:

 for each module that provides all tester resources required by
8 said test:

 for each said tester resources required by said test:

10 for each probe that handles said resource:

 if said probe is unmapped:

12 mapping said resource to said
probe;

14 if said probe is mapped:

 creating a dummy probe;

16 mapping said resource to said
dummy probe;

18 associating said dummy probe with
said probe; and

20 mapping said dummy probe to said
tester interface pins in said module that
22 can connect to said resource in said
module; and

24 wherein said step for solving said Matching Problem that satisfies said
set of constraints comprises:

26 once said solution to said constrained pin-to-probe assignment
problem is obtained, for each test in said subset of tests that requires tester
28 resources to be delivered and/or measured from said tester interface pins
from a single given module of said one or more tester modules:

30 selecting one of said modules that provides all tester resources
required by said test in which a pin-to-probe assignment solution is
32 found;

 reassigning each pin in said solution that has been assigned to
34 a dummy probe to the probe associated with the dummy probe and
removing said dummy probe from said solution;

36 and for each remaining module that provides all tester resources
required by said test, removing all portions of said solution associated with
38 said test from said remaining module.

11. A method in accordance with claim 10, wherein:
2 said step for selecting one of said modules that provides all tester
resources required by said test in which a pin-to-probe assignment solution
4 is found comprises:
 selecting said module in which said pin-to-probe assignment solution
6 for said test is the least- or equally-least cost solution.

12. A method in accordance with claim 10, wherein:
2 for each test:
 for each said plurality of disjoint pin groupings wherein each pin
4 grouping comprises a plurality of tester interface pins that are multiplexed
together and that cannot be used simultaneously in any given test:
6 determining whether said solution to said constrained pin-to-probe
assignment problem contains pin-to-probe assignments that include pins
8 from said disjoint pin grouping; and
 if said solution to said constrained pin-to-probe assignment problem
10 contains pin-to-probe assignments that do include pins from said disjoint pin
grouping, said step for solving said Matching Problem that satisfies said set
12 of constraints is repeated to generate an alternative solution to said
constrained pin-to-probe assignment problem, if said alternative solution
14 exists.

13. A method for assigning tester interface pins to tester fixture
2 probes in a constrained pin-to-probe assignment problem describing a
printed circuit board tester environment, said constrained pin-to-probe
4 assignment problem defined by a set of constraints, said set of constraints
including: a set of nodes each needing at least one resource, a plurality of
6 tester resources wherein said plurality of resources may comprise a plurality
of non-disjoint groupings of resources wherein each grouping realizes a test,
8 a plurality of tester interface pins each connectable to one or more of said

tester resources and may be physically grouped into one or more tester
10 modules, said plurality of tester interface pins comprising a plurality of
disjoint pin groupings wherein each pin grouping comprises a plurality of
12 tester interface pins that are multiplexed together and that cannot be used
simultaneously in any given test, a plurality of probes each connectable to at
14 least one node and to only one of said tester interface pins to deliver a single
tester resource to said node during any given test and the same or a
16 different tester resource for any other given test, and wherein no two nodes
can share a pin, and a plurality of tests which may include a subset of tests
18 where each test in said subset of tests requires tester resources to be
delivered and/or measured from said tester interface pins from a single given
20 module of said one or more tester modules, said method comprising:
modeling said constrained pin-to-probe assignment problem as a
22 Network Flow Problem that satisfies said set of constraints; and
solving said Network Flow Problem using a modified Maximum Flow
24 Algorithm that satisfies said set of constraints to generate a solution to said
constrained pin-to-probe assignment problem.

14. A method in accordance with claim 13, wherein:
2 said solution comprises a maximum matching.

15. A method in accordance with claim 13, wherein:
2 said solving step generates a plurality of solutions, each said solution
having an associated priority.

16. A method in accordance with claim 15, further comprising:
2 selecting a solution from said plurality of solutions, said selected
solution having a corresponding priority that is relatively equal to or higher
4 than each of said respective priorities associated with each other of said
plurality of solutions.

17. A method in accordance with claim 13, wherein:
2 said step for modeling said pin-to-probe assignment problem as a
Network Flow Problem that satisfies said constraints comprises:

4 for each of said plurality of probes connectable to deliver more than
one tester resource:
6 for each tester resource greater than one:
 creating a dummy probe, said dummy probe comprising
8 a virtual probe that operates as a placemaker for said probe;
 mapping said tester resource to said dummy probe;
10 unmapping said tester resource from said probe; and
 associating said dummy probe with said probe; and
12 wherein said step for solving said Network Flow Problem that satisfies
said set of constraints comprises:
14 once a solution to said Network Flow Problem that satisfies said set of
constraints is obtained, reassigning each pin in the solution that has been
16 assigned to a dummy probe to the probe associated with the dummy probe
and removing said dummy probe from said solution.

18. A method in accordance with claim 13, wherein:
2 said step for modeling said pin-to-probe assignment problem as a
Network Flow Problem that satisfies said constraints comprises:
4 for each test in said subset of tests that requires tester resources to
be delivered and/or measured from said tester interface pins from a single
6 given module of said one or more tester modules:
 for each module that provides all tester resources required by
8 said test:
 for each said tester resources required by said test:
10 for each probe that handles said resource:
 if said probe is unmapped:
12 mapping said resource to said
probe;
14 if said probe is mapped:
 creating a dummy probe;
16 mapping said resource to said
dummy probe;
18 associating said dummy probe with
said probe; and

20 mapping said dummy probe to said
tester interface pins in said module that
22 can connect to said resource in said
module; and
24 wherein said step for solving said Network Flow Problem that satisfies
said set of constraints comprises:
26 once said solution to said constrained pin-to-probe assignment
problem is obtained, for each test in said subset of tests that requires tester
28 resources to be delivered and/or measured from said tester interface pins
from a single given module of said one or more tester modules:
30 selecting one of said modules that provides all tester resources
required by said test in which a pin-to-probe assignment solution is
32 found;
reassigning each pin in said solution that has been assigned to
34 a dummy probe to the probe associated with the dummy probe and
removing said dummy probe from said solution;
36 and for each remaining module that provides all tester resources
required by said test, removing all portions of said solution associated with
38 said test from said remaining module.

19. A method in accordance with claim 18, wherein:
2 said step for selecting one of said modules that provides all tester
resources required by said test in which a pin-to-probe assignment solution
4 is found comprises:
selecting said module in which said pin-to-probe assignment solution
6 for said test is the least- or equally-least cost solution.

20. A method in accordance with claim 13, wherein:
2 for each test:
for each said plurality of disjoint pin groupings wherein each pin
4 grouping comprises a plurality of tester interface pins that are multiplexed
together and that cannot be used simultaneously in any given test:

6 determining whether said solution to said constrained pin-to-probe
assignment problem contains pin-to-probe assignments that include pins
8 from said disjoint pin grouping; and
 if said solution to said constrained pin-to-probe assignment problem
10 contains pin-to-probe assignments that do include pins from said disjoint pin
grouping, said step for solving said Network Flow Problem that satisfies said
12 set of constraints is repeated to generate an alternative solution to said
constrained pin-to-probe assignment problem, if said alternative solution
14 exists.

21. A method in accordance with claim 13, wherein said step for
2 solving said Network Flow Problem that satisfies said set of constraints to
generate a solution to said constrained pin-to-probe assignment problem
4 comprises:
 initializing said solution to an empty set and a flow associated with
6 said solution to zero;
 searching for a flow-augmenting path that satisfies said set of
8 constraints;
 if said flow-augmenting path is found, replacing said matching solution
10 with the Exclusive-OR function of the matching solution and the flow-
augmenting path;
12 augmenting said flow along said flow-augmenting path; and
 repeating said searching step through said repeating step until a flow-
14 augmenting path is not found.

22. A method in accordance with claim 17, wherein:
2 said step for modeling said pin-to-probe assignment problem as a
Network Flow Problem that satisfies said constraints comprises:
4 for each test in said subset of tests that requires tester resources to
be delivered and/or measured from said tester interface pins from a single
6 given module of said one or more tester modules:
 for each module that provides all tester resources required by
8 said test:
 for each said tester resources required by said test:

10 for each probe that handles said resource:
 if said probe is unmapped:
12 mapping said resource to said
 probe;
14 if said probe is mapped:
 creating a dummy probe;
16 mapping said resource to said
 dummy probe;
18 associating said dummy probe with
 said probe; and
20 mapping said dummy probe to said
 tester interface pins in said module that
22 can connect to said resource in said
 module; and
24 wherein said step for solving said Matching Problem that satisfies said
set of constraints comprises:
26 once said solution to said constrained pin-to-probe assignment
problem is obtained, for each test in said subset of tests that requires tester
28 resources to be delivered and/or measured from said tester interface pins
from a single given module of said one or more tester modules:
30 selecting one of said modules that provides all tester resources
 required by said test in which a pin-to-probe assignment solution is
32 found;
 reassigning each pin in said solution that has been assigned to
34 a dummy probe to the probe associated with the dummy probe and
 removing said dummy probe from said solution;
36 and for each remaining module that provides all tester resources
required by said test, removing all portions of said solution associated with
38 said test from said remaining module.

23. A method in accordance with claim 22, wherein:

2 said step for selecting one of said modules that provides all tester
resources required by said test in which a pin-to-probe assignment solution
4 is found comprises:

selecting said module in which said pin-to-probe assignment solution
6 for said test is the least- or equally-least cost solution.

24. A method in accordance with claim 22, wherein:
2 for each test:
for each said plurality of disjoint pin groupings wherein each pin
4 grouping comprises a plurality of tester interface pins that are multiplexed
together and that cannot be used simultaneously in any given test:
6 determining whether said solution to said constrained pin-to-probe
assignment problem contains pin-to-probe assignments that include pins
8 from said disjoint pin grouping; and
if said solution to said constrained pin-to-probe assignment problem
10 contains pin-to-probe assignments that do include pins from said disjoint pin
grouping, said step for solving said Network Flow Problem that satisfies said
12 set of constraints is repeated to generate an alternative solution to said
constrained pin-to-probe assignment problem, if said alternative solution
14 exists.